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Vocational Series

SHEET METAL 12 - 22 - 32

(Interim Edition, September 1963)

Province of Alberta

Department of Education

ULUM

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COURSE CREDIT VALUES

Sheet Metal 12 . . . . . 5 credits

Sheet Metal 22 . . . . . 15 credits

Sheet Metal 32 . . . . . 15 or 20 credits

One credit corresponds to a minimum of 40 minutes of instruction time per week.

INTRODUCTION

Sheet metal working is a vital and expanding part of the Canadian industrial scene. There is a continuing demand for "Sheet Metal" skills that assures the qualified worker of employment at good wages right across Canada. The opportunities are unlimited and the range of activities within the field are sufficient to challenge the potential capacities of the best students. The sheet metal field is a wide one permitting well qualified persons to move horizontally as well as vertically. The eventual direction taken by each student will depend on his own particular abilities and the amount of work he is willing to invest in his own future.

This curriculum guide has been prepared for use in Alberta high schools that are suitably equipped and staffed to offer the program. The course is intended to prepare students for entry into employment by developing occupational qualifications.

It is expected that instructors will endeavor to follow this guide closely in order to ensure uniform coverage, and standards of achievement that will be acceptable to industry.

While the ultimate goal for every boy enroling in this program is to graduate and become an indentured, apprenticed sheet metal worker with the opportunity of advanced placement, there will be many who will obtain employment in fields closely related to sheet metal as a result of the training. Those students who complete the program successfully and who possess the necessary ability and determination can attain top positions in the industry.

GENERAL OBJECTIVES

1. To impart to the student, a knowledge of the role the sheet metal worker plays in industry and the opportunities that exist in this field.

2. To equip the student with sufficient skill and knowledge such that he will be highly employable in the sheet metal trade.

3. To enable the student on entering the sheet metal apprentice program, to advance at an accelerated rate on the basis of his proven ability on the job.

SPECIFIC OBJECTIVES

1. To enable students to use the tools and machines of the trade efficiently, accurately and safely.

2. To develop desirable habits concerning safety, good working relationships and proper use of time and materials.

3. To develop high standards of workmanship.

4. To familiarize students with the principles and practices involved in accurate measuring and working to close tolerances.

5. To develop the skills and knowledge required to interpret blueprints accurately as well as to produce accurate drawings.

GENERAL INFORMATION

1. Course Credit Values

Sheet Metal 12 - 5 credits
Sheet Metal 22 - 15 credits
Sheet Metal 32 - 15 or 20 credits

2. Time Allocation

It is recommended that approximately one-third of the time be given to theory and two-thirds to shop practice.

3. Safety Program

Every shop must have an effective safety program. In the sheet metal shop particular attention must be given to the safety measures required in the industry: adequate guards; cleanliness of shop and personnel maintained at a high standard; students properly clothed for their work; etc. Shop organization must be such as to ensure stressing these very important characteristics of the shop program.

A good safety program features the following devices: regular, consistent and thorough instruction; constant vigilance and checking by the instructor; safety posters; student safety committee; adequate first aid equipment; instructor trained and up-to-date in first aid methods; dynamic color painting of machines and equipment; adequate working space about machines; safety lines on the floor about the machines; routine report on accidents however minor; machines and tools in approved working condition; a safety-conscious group of students and instructor.

4. Instructor's Records

The instructor should keep accurate records of:
(a) Student enrolment and attendance.
(b) Student accounts.
(c) Student work activity.
(d) Theory covered.
(e) Tests given.
(f) Student achievement.
(g) Up-to-date inventory of all equipment.

5. Student Records

Instructors should ensure that the student develops and maintains a neat and accurate record of:
(a) Notes on theory.
(b) Daily shop activities.

6. Enrolment

The recommended enrolment for sheet metal classes is 16 students and under no circumstances should it be allowed to increase beyond 20. Two classes may easily be combined for the presentation of theory.

7. Guidance and Vocational Information

Instructors must assume responsibility in their own trade area to ensure that students and school guidance officials are aware of the local situation. It is essential that the instructors be active, interested and informed regarding the opportunities in trade. Students should be encouraged to enrol in Drafting 12 if they are taking the sheet metal courses.

NOTE: In order to permit students from an academic Grade X program to cross over into the vocational program at the Grade XI level, schools may combine the 12 and 22 courses into one course for a total of 20 credits.

8. Projects

It is expected that some projects will be used in Grade X and to a limited degree in Grades XI and XII as vehicles of instruction and as means of securing and retaining student interest. The onus is on the instructor to ensure that the projects selected involve only those operations specified in the course outline and that the time required to complete the project does not encroach upon the time needed to learn other skills and operations.

INSTRUCTIONS ON THE USE OF THE FOLLOWING OUTLINE

The course outline is divided into three columns designated: Basic Information, Operations and Projects, and References. The first column refers to the essential knowledge upon which a well educated employee in the sheet metal industry will depend to adequately carry out the operations and projects listed in the second column. It also includes knowledge of a general nature regarding the trade and the industry, that is not directly related to the operations. The second column outlines the type of activity to be performed by the students and/or instructor in the shop. The third column lists letters which correspond to the text or other reference books listed in the back of the curriculum guide. Instructors are requested to insert references which they consider to be most suitable for the particular topics outlined since the reference column is not considered to be complete. It would be desirable if instructors would also note the time spent on various units. This information will be extremely valuable to the curriculum committee in revising this outline. We ask that instructors keep two copies of this guide, one of which can be returned to the Department with the instructor's notations as mentioned above, and one for the instructor's own records.

The authorized text for Sheet Metal 12 is SHEET METAL PRACTICES, Part I, by Nuendorf and Stevens and published by McGraw-Hill Company of Canada. The projects listed in this book are only suggestive. The instructor should select appropriate projects which involve operations similar to those listed for the projects shown.

SHEET METAL 12 COURSE OUTLINE

Time: 133 hours

Text: SHEET METAL PRACTICE, W. Nuendorf and C. Stevens

References

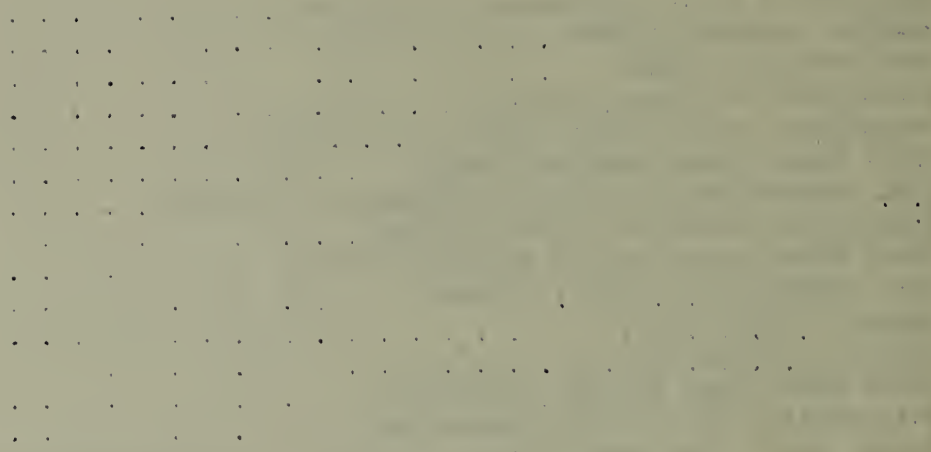
Sheet Metal Practice, Neundorf & Stevens	T
Machine Process, Delmar	MP
Hand Process, Delmar	HP
Measurement & Layout, Delmar	ML
Principles of Air Conditioning, N.W.A.H.A.C	P
Sheet Metal Shop Practice, Bruce	B
S.M. Pattern Drafting & Shop Problems, Daugherty	D
Simplified Sheet Metal Math, Delmar	M
Sheet Metal Principles & Procedure, Stier	S
Unit Outlines S.M. Appr., Techs.	O
Manual 5, N.W.A.H.A.C	WF
Digest, N.W.A.H.A.C	DI
Short Cuts Round Layouts, Kaberlein	K
Triangulation Short Cuts, Kaberlein	KT
Ashrae Guide (American Society of Heating, Refrigeration, Air Conditioning Engineers)	A

In the event of conflicts between texts, the HAND PROCESS, MACHINE PROCESS and ASHRAE are to be the final authority.

The code for this reference section is as follows:

The letter prefix indicates the reference book.
The number series following it indicates the page number, followed by a comma.
The next series indicates the paragraph number.

HP 49,2 would mean, HAND PROCESS, page 49, paragraph 2
(file handles)



Basic Information	Operations & Projects	References
Unit I: Introduction to the Sheet Metal Trade		
A. Divisions of the Trade		
1. Residential and commercial heating and air conditioning. 2. General sheet metal. 3. Kitchen equipment & specialities. 4. Industrial ventilation. 5. Aircraft sheet metal. 6. Estimating. 7. Plastics. 8. Architectural design.	Familiarization tour of the shop. Outline shop precedure and routine.	
B. Working Conditions		
C. Opportunities for Employment and Advancement		
D. The Apprenticeship Program		
Unit II: Shop Safety		
A. Personal Safety B. Machine Safety C. Tool Safety D. Conservation	Introduction to all tools and equipment must be prefaced by appropriate rules. (It is understood that the teaching of safety is to be a continuing process throughout the program.)	T.1, 1-15 W. C. Boards literature & posters.
Unit III: Common Sheet Metals		
A. Gauges		
B. Base Metals		T. 2-3
C. Common Alloys		
D. Ferrous and Non-ferrous		
E. Sheet Steel		
F. Copper		
G. Aluminum		

Basic Information	Operations & Projects	References
H. Tin Plate	Have samples available for class examination.	
I. Terne Plate		
J. Galvonized Iron		
K. Aluminum Alloys		
L. Brass		
M. Monel		
N. Metalurgy of Various Trade Materials		
1. Iron and steel. 2. Tin. 3. Lead. 4. Zinc. 5. Solder. 6. Alloys.		
O. Methods of Weather and Rust-proofing		
Unit IV: Hand Tools and Stakes		
A. Common hand tools only, their description, care and safe use.	Proper use of the tools and equipment demonstrated prior to having students work with them.	T. 3-4-5
B. Sheet metal stakes, their description, care and safe use.		T. 27-28
C. Rivets, riveting, grooving and wiring.	Simple exercises or projects involving the use of these tools.	T. 29-35
D. Allowances for grooving and wiring.		
Unit V: Soldering		
A. Introduction		T. 5
B. Soldering Coppers		H.P. 63
1. Description. 2. Types and shapes. 3. Weights of soldering coppers.	Demonstrate the forging of a soldering copper.	H.P. 63

Basic Information	Operations & Projects	References
B. Methods of heating the soldering copper. Stress safety precautions.	Use of hammer and anvil. Heat the soldering coppers using gas furnace only.	H.P. 59-60 T. 8,2
C. Tinning the soldering copper.		
1. Need for cleaning surfaces that require tinning. 2. Dip or tinning solutions.	Use tinning solutions.	T. 7,3
D. Fluxes - types, uses and method of application.		H.P. 65-66 T. 6
E. Defluxing - reasons for.	Demonstrate defluxing methods.	
F. Safety - safe handling of acids, storage of acids and first aid treatment for acids.		
G. Chemical action of acids, bases and salts.		
H. Solder - types and uses of various solders.	Apply solder. Demonstrate solder flow and penetration. Methods of testing for leaks. Projects should include the use of tin plate and galvanized iron.	T. 5-6 T. 8-9
Unit VI: Stationary Floor Machines		
A. Squaring shears - description and use.	Safe operation, adjustment and maintenance. Cut on trim sheet metal.	T. 12-13
B. Bar Folder - description and use.	Safe operation, adjustment and maintenance. Form edges, using bar folder.	T. 14-16
C. Standard Hand Brake - description and use.	Safe operation, adjustments and upkeep. Form bends, sharp and round.	T. 17-19

Basic Information	Operations & Projects	References
D. Box and Pan Brake- description and use.	Safe operation, adjustments and maintenance. Form box bends.	T. 20-21
E. Slip Roll Former- description and use.	Safe operation, adjustments. Form cylinders and cones.	T. 22-24
F. Drill Press - description and use. Drills and drilling speeds.	Safe operation, adjustments and upkeep. Demonstrate safe methods of holding stock for drilling. Drill stock of various thicknesses.	T. 25-26
G. Lock Former- description and use, metal allowances.	Safe operation, adjustment and maintenance.	
H. Spot Welder- description and uses.	Safe operation, current adjustments for various gauges. Maintenance of points.	
I. Tool Grinder - description, use and grinding wheels.	Safe operation, care and adjustments. Mount and dress wheels. Correct operation for drills.	
Unit VII: Bench and Rotary Machine		
Turner, easy - edger, elbow, burr, wiring - Description and use. Crimping, beading, setting down - description and use. Allowances for various shapes and edges.	Demonstrate Safe operation, adjustment and care of these machines, adjustments for allowances. Students should use all machines in completing exercises or projects.	H. P. 38-66

Basic Information	Operations & Projects	References
Unit VIII: Layout and Fabrication of Sheet Metal Projects		
NOTE: It is hoped that students registered in this course will be taking Drafting 12 concurrently. If this is not the case, the instructor will have to teach the following units from Drafting 12: Unit Two - Instruments and Materials Unit Three - Use of Instruments Unit Four - Lettering Unit Five - Geometric Construction	This unit is to be taught in a drafting classroom.	
A. Elementary Drafting	Bisection of lines.	M. 60-85
B. Projection of a Block	Erecting perpendiculars. Bisection of angles.	D. 12-22
C. Projection of a Block	Construction of geometric figures.	
D. Projecting a cylinder cut by a given plane.	The circle - properties. Intersecting lines.	
E. Projecting a pyramid cut by a given plane.	Developing the ellipse. Transferring angles. Parallel lines.	
F. Simple Layout	Boxes, pans, etc., blueprint reading. Allowances for seams, folds and joints.	T. 46-74 T. 77-90
G. Developing patterns for cylinder intersections.	Parallel line development. 90° and 45°, equal and unequal diameters, on center. Allowances for seams and joints. Notching.	D. 32-34
H. Developing patterns for regular, or right conical forms.	Radial line development. Plan and elevation relationships. Methods of determining apex. Allowances for seams and joints. Notching. Right cone. Frustrum and truncated cones. Funnel. Flaring pans.	D. 64 D. 64 D. 67 D. 73 D. 72

SHEET METAL 22

Time: 400 hours

NOTE: Whereas Sheet Metal 12 is an exploratory course open to all Grade X students, Sheet Metal 22 and 32 are definitely vocational, and only those students who have displayed ability and aptitude for the program should be encouraged to continue.

SHEET METAL 22 COURSE OUTLINE

Texts: HAND PROCESSES - Delmar Publication
MACHINE PROCESSES - Delmar Publication

References: Same as for Sheet Metal 12.

Basic Information	Operations & Projects	References
Unit I: Shop Procedure and Safety		
Personal safety. Machine safety. Tool safety. Conservation of materials and equipment.	The introduction of students to all tools and equipment must be prefaced by thorough instruction with strong emphasis on safety. Rules and procedure must be stressed regarding each of the above and must be adhered to.	
Unit II: Common Sheet Metals		
A. Chemical and physical characteristics of ferrous and non-ferrous metals. Review metals covered in S.M. 12 with emphasis on depth.		
B. Stainless steel, blue plate, everdur, bronze, solder, bismuth, antimony, zinc, lead, tin - their uses and limitations.		H.P. 1-6

Basic Information	Operations & Projects	References
Unit III: Hand Tools and Stakes		
A. Review	Review of the tools covered in Grade X.	
B. Introduce remaining tools.	As listed.	O. 2,4
C. Cover the remaining stakes.	As listed.	O. 2,5
D. Seams and edges.	Fabricate as listed, those that apply. Use of formulae.	O. 4,5 H.P.
Unit IV: Soldering		
A. Review	Review S.M. 12 unit and refer to textbook.	H.P. 56-70
B. Heating Equipment and Fuels.	Safe operation of various types of heating equipment.	B. 137-154
C. Applying Solder	Preheating when necessary. Methods of applying solder to various types and positioned joints.	O. 5,3 B. 137-154
D. Finishing Soldering Joints		
1. Filing - types, care and uses of files.	Demonstrate correct use of files.	FILE PHILOSOPHY by Nicholson File Co.
2. Sanding - grades and use of coated abrasives, use of hand and power equipment. Safety precautions.	Demonstrate the correct use of sanding materials and equipment prior to students using them.	Manufacturers' Manuals
Unit V: Stationary Floor Machines		
Review - Description, parts, and use of each of the following: Squaring shears, bar folder, standard hand brake, box and pan brake, slip roll former, drill press, lock former, spot welder and tool grinder.	Review the correct methods of using these machines stressing safety precautions. Emphasize correct adjustment and allowances. Students should fabricate suitable exercises or projects of a more advanced nature.	M.P. 1-37

Basic Information	Projects & Operations	References
Unit VI: Bench and Rotary Machines		
Review machines covered in S.M. 12, Unit VII. A thorough knowledge and understanding of the uses of these machines is required now.	Review the safe operation, adjustment and care of these machines by demonstrations followed by students use of the machines in making projects and exercises. Emphasize the development of skill.	M.P. 38-66
Unit VII: Layout and Fabrication of Sheet Metal Projects		
Include the following: Units from Drafting 12 if students did not take the Drafting 12 course: Unit Seven - Orthographic projection Unit Eight - Dimensioning Unit Nine - Axonometric projection	(This unit to be taught in a drafting room). An extension of S.M. 12, Unit VIII. Allowances for seams and joints. Notching.	
Surface development of projects involving parallel line method.	Projects: 3" pipe (grooved seam) 3" pipe (riveted seam) Rectangular pan Pentagon box with lid Tin cup Chimney jack Stretching exercise 90° elbow, 45° elbow offset 90° equal diameter tee 90° unequal diameter tee 45° unequal diameter tee 60° unequal diameter tee 60° unequal diameter off center tee Square intersecting a cylinder off center at 90°. Rectangle intersecting a cylinder off center at 90°.	O. 6,1
Surface development of projects involving radial line method.	Taper. Funnel. Funnel with splash lip. Cone. Frustrum of a cone. Truncated cone. Frustrum of a pyramid. Truncated hexagon. Truncated hexagon ($\frac{1}{4}$ twist). Dust pan.	O. 6, 1

Basic Information	Operations & Projects	References

Unit VIII: Introduction and General Principles of Air Movement as Applied to a Gravity Furnace

Fundamental principles in gravity heating.

A. Definition of terms used in heating. — Manual 3 0.12, 6, (c)

1. Heat.
2. Temperature.
3. British Thermal Unit.
4. Heat loss or heat flow.
5. Convection.
6. Conduction.
7. Radiation.
8. Evaporation.

B. Measurement of Air Flow

Study plans and blueprints. Field trip to observe typical installations would be desirable.

1. Static pressure.
2. Velocity.
3. Total pressure.

C. Force causing gravity circulation.

D. Location of warm air registers. — W.F. 3

E. Rise per running foot of leaders. — W.F. 25

F. Location of return air intakes. — W.F. 5

G. Location of furnace. — W.F. 5 & 24

H. Re-cementing and assembling of furnace. — W.F. 19-20

SHEET METAL 32

Time: 400 or 532 hours

Texts: HAND PROCESSES - Delmar Publication
MACHINE PROCESSES - Delmar Publication

References: Same as for Sheet Metal 12.

Basic Information	Operations & Projects	References
Unit I: Shop Procedure and Safety		
Personal safety. Machine safety. Tool safety. Conservation of materials and equipment.	It is very essential in the interests of the safety of the students and equipment that thorough instruction be given again in the correct use of tools and equipment.	
Unit II: Industrial and Labour Relations		
A. Management	Bring in guest speakers: A member of the local Masters Sheet Metal Association.	Offices: Red Deer, Calgary, Edmonton, Lethbridge, Grande Prairie.
B. Labour	A member of the local Sheet Metal Workers' International Union.	Offices: Red Deer, Calgary, Edmonton, Lethbridge.
C. Workmen's Compensation Board	Representative to address students and show films.	Offices: Calgary, Edmonton, Lethbridge, Grande Prairie.
D. Apprenticeship Board	Representative invited to address students.	Offices: Same as above.

Basic Information	Operations & Projects	References

Unit III: Layout and Pattern Development

A. Covering parallel line, radial line and triangulation.

Each student should be required to develop the patterns for the following projects, after which the students will fabricate them in the shop.

90° rectangular change elbow
45° rectangular elbow
Rectangular offset
Two-way rectangular offset
Square to round on center
Square to round off center
Square to round on a pitch
Rectangle to round off center, two ways
Rectangle to rectangle, 1/8 twist
Leader head
Eavestrough mitre including return end
Rectangle to rectangle, 1/4 twist, flat on two sides
Rectangular roof cap
Stationary louver
Tapering three piece 90° elbow
Tool box
Goose neck elbow
Down draft diverter
Tapering offset (round)
Rectangle to round offset
Quart measure
Pint measure

Basic Information	Operations & Projects	References
Unit IV: Air Movement in Residential Forced Air Systems		
A. Introduction to warm air heating.	Projects: Each student should be required to fabricate the projects for which he has developed the layout and pattern in Unit III.	Dl. 3
B. How engineers are classified.		Dl. 3
C. Basic principles.		Dl. 4
D. How heat is measured.		Dl. 5
E. How heat travels.		Dl. 6
F. How our bodies lose heat.		Dl. 7
G. Comfort.		Dl. 8
H. Air flow in ducts.		Dl. 9
I. Heat loss (or gain) of air flowing in ducts.		Dl. 14
J. Heat losses and heat gains of buildings.		Dl. 16
K. Perimeter heating.		Dl. 17
L. Continuous air circulation.		Dl. 20

REFERENCES

1. HAND PROCESSES - Sheet Metal Series - Delmar Publication Inc.
   - available through Thomas Nelson and Sons (Canada) Ltd.

2. MACHINE PROCESSES - Sheet Metal Series - Delmar Publications Inc.
   - available through Thomas Nelson and Sons (Canada) Ltd.

3. MEASUREMENT AND LAYOUT - Sheet Metal Series - Delmar Publications Inc.
   - available through Thomas Nelson and Sons (Canada) Ltd.

4. PRINCIPLES OF AIR CONDITIONING (Unit I) (Latest Edition) - National Warm Air Heating and Air Conditioning Assoc, 4195 Dundas Street W., Toronto.

5. SHEET METAL SHOP PRACTICE by Leroy F. Bruce - General Publishing Co. Ltd. 222 Adelaide St. W., Toronto.

6. SHEET METAL - Pattern Drafting and Shop Problems (Revised) by Daugherty and Powell - Copp Clark Publishing Co. Ltd., Toronto 1, Ontario.

7. SIMPLIFIED SHEET METAL MATHEMATICS - Delmar Publications Inc.
   - available through Thomas Nelson and Sons (Canada) Ltd.

8. SHEET METAL PRINCIPLES AND PROCEDURES by Emanuele Stieri, Prentice-Hall Inc., Englewood Cliffs, New Jersey.

9. UNIT OUTLINES FOR SHEET METAL APPRENTICES - Institutes of Technology, (Calgary and Edmonton)

10. MANUAL FIVE - National Warm Air Heating and Air Conditioning Association, 4195 Dundas Street, W., Toronto.

11. THE DIGEST - National Warm Air Heating and Air Conditioning Association, 4195 Dundas Street, W., Toronto.

12. SHORT CUTS FOR ROUND LAYOUTS by J.J. Kaberlein - The Bruce Publishing Company, Milwaukee, Wis.

13. TRIANGULATION SHORT CUTS FOR LAYOUTS by J.J. Kaberlein - The Bruce Publishing Company, Milwaukee, Wis.

14. ASHRAE - Guide, published by the American Society of Heating, Refrigeration, Air Conditioning Engineers.

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